

Write-Once Optical Recording Medium

Field of the Invention

The present invention is related to a write-once optical recording medium,
5 and in particular to a write-once optical recording medium having a recording
layer of an inorganic compound.

Background of the Invention

US patent No. 5,252,370 and US patent No. 5,334,433 disclose a write-once
10 optical recording medium having a recording layer containing an inorganic
compound, i.e. silver oxide or iron nitride. Upon exposure to recording laser
light, an inorganic compound in the recording layer decomposes to release a gas,
creating a space in the recording layer. A recess is created on the substrate
surface or the reflective layer due to the pressure of evolving gas. The space
15 and recess cause a change of optical conditions, resulting in a substantial
lowering of reflectivity where the laser light is irradiated. This enables
reproduction in accordance with the CD standard.

Summary of the Invention

20 A primary objective of the present invention is to provide a write-once
optical recording medium which is free from the drawbacks of the prior art.

Another objective of the present invention is to provide another option of
making a write-once optical recording medium in addition to silver oxide and
iron nitride used in US patent No. 5,252,370 and US patent No. 5,334,433.

25 A write-once optical recording medium made according to the present
invention having a recording layer containing a mixed nickel oxides, NiOx,
wherein said NiOx comprises NiO and Ni₂O₃ as a major portion.

In comparison with silver oxide and iron nitride, a NiOx recording layer is
more stable in air. As a result, the write-once optical recording medium is more
30 reliable for an extended period of time both before and after recording.
Moreover, the NiOx recording layer will not only decompose to release a gas but
become transparent from its original black color upon exposure to recording

laser light, and these enable reproduction of signals in accordance with not only the CD standard but DVD and HD-DVD standards. The NiOx mixed oxides is non-toxic and has a relatively lower decomposition temperature.

5 Detailed Description of the Invention

The present invention discloses a write-once optical recording medium comprising a substrate, a recording layer on a surface of said substrate, a dielectric layer on said recording layer, and a reflective layer on said dielectric layer, said recording layer comprising a mixed nickel oxides, NiOx, wherein said
10 NiOx comprises NiO and Ni₂O₃ as a major portion. Upon exposure to recording laser light, said NiOx in the recording layer decomposes to release a gas and becomes transparent from its original black color, creating a space and mark in the recording layer. Since the substrate is also heated and softened, a recess is created in the substrate surface due to the pressure of evolving gas.
15 The space, recess and color-change cause a change of optical conditions, resulting in a substantial change in reflectivity where the laser light is irradiated. This enables reproduction in accordance with the DVD and HD-DVD standards.

Alternatively, the present invention discloses a write-once optical recording medium comprising a dielectric layer on a surface of a substrate, a recording
20 layer of NiOx on said dielectric layer, and a reflective layer on said recording layer. Upon exposure to recording laser light, said NiOx in the recording layer decomposes to release a gas and becomes transparent from its original black color, creating a space in the recording layer. The pressure of the evolving gas causes a recess to be created in the reflective layer. The space, recess and
25 color-change cause a change of optical conditions, resulting in a substantial change in reflectivity where the laser light is irradiated. This enables reproduction in accordance with the DVD and HD-DVD standards.

The write-once optical recording mediums made according to the present invention are substantially the same in structure as those disclosed in US patent
30 No. 5,252,370 and US patent No. 5,334,433, except that the former uses the mixed nickel oxides, NiOx, in the recording layer and the latter two US patents contain silver oxide or iron nitride in the recording layer. The disclosures in

these two US patents are incorporated herein by reference. The mixed nickel oxides, NiOx, used in the present invention will decompose and release oxygen upon heating, which is at a temperature of about 150-370°C depending on the composition thereof. Further, the resulting product NiO from the
5 decomposition of the NiOx which is black is transparent.

Preferably, the recording layer has a thickness of 30 to 100 nm.

The recording layer of the present invention is preferably formed by gas phase growth techniques such as sputtering and evaporation techniques, especially by a reactive sputtering technique using oxygen gas as a reactive gas,
10 and more preferably, an RF sputtering technique.

The recording layer of the mixed nickel oxides, NiOx, is formed by reactive sputtering in a low vacuum condition containing oxygen gas using NiO as a target. Preferably, oxygen gas is used in admixture with an inert gas such as Ar and the flow rate of oxygen gas is 10 to 100% of the total flow rate of all gases.

15 The pressure during reactive sputtering for depositing NiOx preferably ranges from 3×10^{-1} to 60 Pa, and more preferably from 1 to 6 Pa.

Preferably, said dielectric layer is 10-300 nm in thickness, which may be made of silicon oxide or Al_2O_3 .

Preferably, said reflective layer is 80-130 nm in thickness. Preferably,
20 said reflective layer is made of a member selected from the group consisting of Ag, Al, Au, Pt, Cu and an alloy thereof

Examples of the present invention are given below by way of illustration.

EXAMPLE 1

25 An optical recording disk was fabricated by forming on a surface of a substrate a dielectric layer of silicon oxide, a recording layer of mixed nickel oxides, a reflective layer and a protective film of UV curable resin.

The substrate used was a disk having a diameter of 120 mm and a thickness of 0.6 mm injection molded from polycarbonate resin with grooves configured at
30 the same time.

The dielectric layer was formed to a thickness of 200 Å by sputtering using SiO_2 as a target.

The recording layer was formed to a thickness of 600 Å by reactive RF sputtering in an atmosphere containing oxygen gas and Ar gas. The sputtering pressure was 2.6 Pa and the ratio of flow rates of oxygen and Ar gases was 36/100. The target used was NiO and the sputtering power was 200 W. The
5 composition of recording layer was analyzed by ESCA spectroscopy to find that it consisted of NiO and Ni₂O₃.

The reflective layer was formed to a thickness of 1,000 Å by sputtering using a Ag as a target.

For the optical recording disk made in this example, DVD signals (3T, 5T,
10 7T, 9T and 11T) were recorded and reproduced. Laser light of 12 mW was directed for recording and laser light of 0.5 mW directed for reproduction. The laser light had a wavelength of 405 nm.

The optical recording disk prepared in this example was subjected to a storage durability test of storing over 1,000 hours in normal condition. No
15 substantial increase of error rate was found.